
APPENDIX E.2

Aquatic Macroinvertebrate Biotic Field Surveys and Taxonomy – 2000 Results

Submitted by Kurt L. Schmude, Ph.D., Lake Superior Research Institute, December 22, 2000

INTRODUCTION

The Wisconsin Department of Natural Resources (WDNR) initiated a broad-based inventory (flora, fauna, and natural communities) of the Wolf River GMU in 1999. This inventory project will support the state master planning process by providing information to public agency administrators, planners, and managers and aiding the prioritization of sites and species for protection by public and private conservation organizations. Field inventory of aquatic macroinvertebrates is essential for managing and protecting natural resources and thus an important component in the biotic inventory process. Many aquatic macroinvertebrates are sensitive indicators of habitat quality and land use.

The inventories will allow biologists and planners to understand the distribution and relative abundance of some of the most important aquatic species and communities, and to select the most appropriate sites for conserving rare taxa and intact natural communities. The information will also be used for comparing biota of manipulated versus natural systems. Several potentially rare aquatic insects are known, suspected, or have a high probability of occurring within the project area. Because no systematic search for the species has occurred, WDNR is presently unable to assign status or conservation priority to many of them with confidence.

This report documents the results of the second consecutive year of the biotic field survey and the taxonomic analysis performed for the aquatic macroinvertebrates collected in the Wolf River Geographic Management Unit (GMU) during 2000. The first year concentrated only on the immediate lower Wolf River Basin, from Shawano to Fremont (Schmude 1999). The current study was expanded to include all of the GMU. Not only was additional work completed in the area that was sampled in 1999, but several exceptional sites that were previously sampled were revisited. Consequently, the immediate lower Wolf River Basin was sampled more intensively during the two-year study than the other areas of the GMU. Additional factors that contributed to the disparity in sampling effort were 1) the large size of the GMU, 2) the enormous number of aquatic sites within the GMU, and 3) time and financial constraints.

The format of this report is very similar to the 1999 report, and parts of the text are identical. Table 1 documents all of the sites that were sampled in 2000 and includes the data from 1999 for sites that were re-sampled, providing a comparative and cumulative analysis for those sites.

METHODS

A total of 114 sites were sampled for aquatic macroinvertebrates; data from one additional site from a previous study were also included. Many of the sites were chosen based on the future inventory needs that were outlined in "Biotic Inventory & Analysis of the Wolf River Basin: An Interim Report" (WDNR 2000). Sites and areas were listed and mapped as having high potential for conservation and inventory

Sites (#) were located in Forest (5), Langlade (8), Marathon (2), Oneida (1), Outagamie (13), Portage (11), Shawano (28), Waupaca (28), Waushara (12), and Winnebago (6) counties. Sampling occurred on May 17-19, 22-27, and June 5-9, 2000. Dr. Kurt Schmude and two student assistants, Chris Brennan and Jamie Denninger performed sampling.

Lotic Sites

In total, 67 lotic sites were sampled. At each site, the available habitats were determined and each person was responsible for a particular habitat(s). Sampling was performed using a D-frame aquatic net (approx. 1-mm mesh opening). The kick-sampling method was used in riffles and runs, while undercut banks were sampled by rigorously manipulating the net in the undercut substrates. Sample debris was placed on a large mesh screen over a large plastic tray and the organisms fell through the mesh into the tray. Sample debris was then searched for cryptic, slow-moving organisms; all specimens were preserved in plastic vials containing 70% ethanol. Submerged structures (wood, rocks) were taken out of the water and inspected, and other habitats (water surface, shoreline) were visually inspected for organisms and exuviae. Four deep-water sites on the Wolf River were also sampled (SCH100-101, 103, and at Hwy M in Outagamie Co.). The deep-water areas were sampled using a large Ekman grab. In general, habitats that were routinely sampled included the following:

- A. rocky riffles and runs
- B. submerged wood and roots
- C. undercut banks
- D. submerged and emergent vegetation
- E. sandy, silty, and/or clayey runs near the shoreline
- F. shallow and deep sand bars and sand bar drop-offs
- G. surface (surface-dwelling organisms)
- H. shorelines and bridges (exuviae)

Lentic Sites

In total, 47 lentic sites were sampled. The available habitats were again determined and each person was responsible for a particular habitat(s) or area(s) to sample. The same methods were employed. Habitats that were sampled included the following:

- A. shallow, vegetated areas
- B. water column of deeper areas
- C. submerged wood
- D. shallow sandy/silty areas near the shoreline
- E. surface
- F. shoreline searches for exuviae

In addition, the sites listed below were sampled using submerged bottle traps. Two to six traps were placed in shallow, vegetated areas. The traps were deployed from May 17-18 or 19, May 22-24 or 25, and June 5-7, ranging from 24-72 hours. The sites were chosen based on previous experience with the sites and the probability that larger numbers and diversity of macroinvertebrates would be captured passively with the traps, rather than actively with nets. Several of the sites are currently being managed by the WI

DNR.

- A. ponds and flowages on LaSage Property (SCH003-007) (May 17-19)
- B. Shioc Mitigation Site-marsh (SCH008) (May 17-19, June 5-7)
- C. Maine Wildlife Area-swamp (SCH009) (May 17-19, June 5-7)
- D. McDonald Flowage-marshes (SCH010: May 17-19; SCH011: May 18-19)
- E. Frog pond, marsh, and oxbow at Mosquito Hill Nature Center (SCH021-023) (May 17-19)
- F. Pikes Peak Flowage-marsh (SCH024) (May 22-25)
- G. Shaky Lake State Natural Area (SNA) (SCH025) (May 22-24)
- H. oxbow, Hwy 156 near Wolf River (SCH052) (May 22-25, June 5-7)
- I. bog in Navarino State Wildlife Area (SCH053) (May 22-25)

Sampling Problems

- A. Restricted seasonal sampling. Populations of aquatic insects were high in numbers for most spring emergents. However, populations of winter stoneflies and late summer/early fall species were very low in numbers or absent. The inability to get contracts in place as soon as possible prevented field crews from working earlier in the year (March-early May), especially before high water levels occurred.
- B. High water levels due to frequent and heavy rains. The lower Wolf River below Shawano was too high during the sampling period to allow for safe sampling, even in the shallow areas along the banks. Although the lower Wolf River was sampled using an Ekman grab at 4 sites, sampling with an aquatic net was very limited. High water levels and strong currents were also prevalent on streams throughout the basin, but sampling was still possible at all of the smaller streams.

RESULTS

Table 1 below lists each site, the minimum number of taxa identified at each site, the habitats sampled, the number of new county records, and pertinent notes on the sampling effort or identification of the site. Sites are grouped into the following major categories:

- A. Very large rivers
- B. Medium to large rivers
- C. Small to medium-sized rivers
- D. Shallow marshes, flowages, floodplains
- E. Oxbows
- F. Swamps
- G. Bogs
- H. Springs, spring ponds
- I. Ponds, woodland pools
- J. Lakes

Taxa were identified to the lowest taxonomic level possible based on current literature and the expertise of the participating taxonomists (Dr. Kurt Schmude - all macroinvertebrates, Mr. Wayne Steffens - odonates).

In some cases, specimens were identified to a higher taxonomic level due to the lack of a key to species, even though two or more species were clearly recognizable among the specimens; sites where this situation occurred are marked with a plus (+). Seven sites were sampled with both nets and submerged bottle traps.

The number of taxa collected by each method is listed, along with the total number of different taxa collected by both methods.

Habitat codes are as follows: A=riffle, B=run, C=pool, D=lake, E=bank.

New county records were determined based on published scientific literature, previous WI DNR surveys of macroinvertebrates performed by the author, and unpublished data known to the author. Many groups of aquatic macroinvertebrates have not been intensively studied at the species level, and detailed data on their distribution in Wisconsin is not available. Data for the following taxa were available for the determination of new county records:

- A. all Heteroptera (aquatic and semi-aquatic bugs)
- B. almost all aquatic Coleoptera (beetles, except Chrysomelidae, Curculionidae, Scirtidae)
- C. Baetiscidae, Heptageniidae, Pseudironidae (mayflies)
- D. Perlodidae (stoneflies)
- E. Hydropsychidae, Brachycentridae (caddisflies)

Sampling effort was restricted at some sites due to the difficult and/or dangerous conditions at the site. Site records followed by "Not processed" include samples from small to medium-sized streams that were not taxonomically processed due to the large volume of samples collected and the perceived sameness of that particular habitat.

TABLE 1.

<u>Site</u>	<u># Taxa</u>	<u>Habitat</u>	<u>New County Records</u>	<u>Notes</u>
<u>VERY LARGE RIVERS</u>				
Wolf River (7 sites)				
no sourcecode	0(dredge)	B		Co. Hwy M, Outagamie Co.
SCH100	11(dredge)	B		New London
SCH101	0(dredge) 31(net)	B,E	1	Gill's Landing
SCH102	20(net)	B	1	Fremont
SCH103	7(dredge) 24(net) 30(total)	B		near Hwy H
SCH126	53	A,B,C,E	3	Wolf River Landing Road
SCH130	48	A,B,C,E		Chaney Lane
SCH132	53	B,E		Meister-Stockley Road
Red River				
SCH116	40	B,C,E		high water, waterfall, bedrock
<u>MEDIUM TO LARGE RIVERS</u>				
Crystal River				
SCH027	45	B,E		
Embarrass River				
SCH058	71	A,B,C,E	4	
SCH059	36	E	1	
SCH060	40	A	1	
TOTAL	94			

<u>Site</u>	<u># Taxa</u>	<u>Habitat</u>	<u>New County</u> <u>Records</u>	<u>Notes</u>
Middle Branch Embarrass River				
SCH071	60	B,E	3	
SCH120	46	A,B,E		
North Branch Embarrass River				
SCH115	49	A,B,E		
South Branch Embarrass River				
SCH002	27	B		
Ninemile Creek				
SCH125	18	B,E		
Pickrel Creek				
SCH134	34	B,E	1	
Pigeon River				
SCH061	45	A,B,C,E		
Pine River				
SCH049	28	B,E		
Shioc River				
SCH056	51	A,B,C,E		
Waupaca River				
SCH093	61	A,B,C,E		
West Branch Red River				
SCH119	41	A,B,C,E		
Little Wolf River				
SCH065	50	A,B,C,E	1	
SCH112	24	A,B,E		

SMALL TO MEDIUM-SIZED RIVERS

Alder Creek				
SCH043	20	B,E		
SCH044	--	B,E		Not processed
Allen Creek				
SCH015	13	A		
Beetle Creek				
SCH001	--	C,E		Not processed
Bradley Creek				
SCH110	43	A,B,E		
Cedar Creek #1				
SCH019	--	B,E		Not processed
spring seep to Cedar Creek #1				
SCH020	9	B,E	1	
Cedar Creek #2				
SCH051	28	A,B,E		
Cleveland Creek				
SCH113	25+	B,E		

Comet Creek				
SCH066	46	B,E		
Site	# Taxa	Habitat	New County Records	Notes
SCH072	--	A,B,E		Not processed
Emmons Creek				
SCH029	38	B,E		
SCH030	46	A		
Flume Creek				
SCH109	45	A,B,E		
Krause springs and creek				
SCH121	47	A,B,C,E	2	
Logemanns Creek				
SCH068	34	A,B,E		
McGee Creek				
SCH124	47	A,B,E	1	
Mill Creek				
SCH105	36	A,B,E		
Murry Creek				
SCH031	30	B	3	
Pearl Creek				
SCH032	5	A		
Peterson Creek				
SCH096	47	A,B,E		
Pine River				
SCH034	32	B,E		
Pony Creek				
SCH069	47	A,B,C,E		
SCH070	--	A,B,E		Not processed
Porters Creek				
SCH045	--	B,E		Not processed
Potters Creek				
SCH104	--	A,B,E		Not processed
Radley Creek				
SCH028	37	B,E		
Rat River				
SCH038	19	A,B,E		
SCH039	23	B,E		
Spring feeder to Red River				
SCH117	11	B	1	
Tributary to Sannes Creek				
SCH095	23	B,E		
Silver Creek				
SCH118	41	A,B,E		
Spider Creek				
SCH133	23	A,B,E	1	
Twin Creek				
SCH055	--	B,E		Not processed

Upper Pine River

SCH033	36	A,B,E	New County
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<u>Site</u>	<u># Taxa</u>	<u>Habitat</u>	<u>Records</u>	<u>Notes</u>
Walla Walla Creek				
SCH026	--	B,E		Not processed
West Branch Shioc River				
SCH054	30	A,B,E	1	
Whitcomb Creek				
SCH106	32	A,B,E	1	
S. Fork Whitcomb Creek				
SCH107	28+	B,C,E		
Willow Creek				
SCH036	--	A,B,E		Not processed
unnamed creeks				
SCH037	27	A,B,E		
SCH063	8	A,B,E		

SHALLOW MARSHES/FLOWAGES/FLOODPLAINS (9 sites) /1999 data/

SCH004	5			LaSage flowage, north unit
SCH005	15		1	LaSage flowage, south unit
<i>[SCH99-103] [20(net) 13(bottle) 27 (total)]</i>				
Grand Total 34				

SCH008	16(May 17-19) 30(June 5-7) 15(May 17-19, ditch) 39(total)	Shioc Mitigation Site
<i>[SCH99-104] [22(net) 15(bottles) 31(total)]</i>		
Grand Total 58		

SCH010	13	1	McDonald Marsh (south unit)
SCH011	22		McDonald Marsh (north unit)
<i>[SCH99-110] [25(net) 18(bottles) 36(total)] [5]</i>			
Grand Total 49			

SCH024	31(net) 20(bottle) 41(total)	7	Pikes Peak Flowage
SCH023	47(net) 32(bottle) 67(total)	1	"Marsh" Mosquito Hill Nature
New County			

<u>Site</u>	<u># Taxa</u>	<u>Habitat</u>	<u>Records</u>	<u>Notes</u>
SCH040	23			Rat River, Hwy M
SCH041	22		3	Rat River, Hwy W

OXBOWS (2 sites)

SCH022	26(net) 12(bottle) 31(total)	1	Mosquito Hill Nature Center
SCH052	44(net) 42(bottle) 65(total)	4	Hwy 156 near Wolf River

SWAMPS

SCH009	25(May 17-19) 36(June 5-7) 41(total)	2	Maine Wildlife Area (swamp)
<i>[SCH99-105] [38(bottle)]</i>			<i>[3]</i>

Grand Total 52

BOGS (3 sites)

SCH025	8(net) 20(bottle) 25(total)			Shaky Lake
SCH053	14(bottle)	4		Navarino Bog
	[SCH99-107]	[19(net) 10(bottles) 26(total)]	[11]	
Grand Total 31				
SCH064	26	1		Mud Lake bog SNA

SPRINGS/SPRING PONDS (5 sites)

SCH003	7 (net) 3 (bottle) 10 (total)			spring pond, LaSage Prop.
	[SCH99-102]	[32(net)]	[7]	
Grand Total 39				
SCH016	25	2		spring pond, Todd Close Prop.
SCH017	26			spring pond, Todd Close Prop.
SCH050	7			Cedar Springs
SCH111	21			woodland spring pond

PONDS/WOODLAND POOLS (6 sites)

SCH006	7			woodland pool, LaSage Prop.
SCH007	12			woodland pool, LaSage Prop.
SCH018	14			retention pond, Close Prop.
SCH021	36(net) 17(bottle) 41(total)	2		"Frog pond" Mosquito Hill
SCH048	32	1		woodland pool, SNA
SCH099	12			woodland pool, Myklebust Lk.

LAKES (22 sites)

SCH012	18	D		Wolf Lake
SCH013	16	D	1	Pickrel Lake
SCH014	38	D	1	Fountain Lake
SCH035	17	D		Gilbert Lake
SCH042	28	D	1	Lake Poygan
SCH046	13	D		unnamed bog lake
SCH047	13	D	1	fishless lake SNA
SCH057	19	D		Lulu Lake
SCH062	11	D		Keller Lake
SCH067	11	D		Wilson Lake
SCH094	23	D	1	Grenlie Lake SNA
SCH097	19	D		Rollofson Lake
SCH098	29	D		Myklebust Lake
SCH108	24	D		Sunset Lake
SCH114	20	D	1	Hennig Lake
SCH122	9	D		Rabe Lake
SCH123	34	D	2	Lawrence Lake
SCH127	4	D		Himley Lake (south end)
SCH128	11	D		Himley Lake (north end)
SCH129	27	D	1	Pine Lake

SCH131	37	D	D	2	Little Rice Lake
no source code 117		D	1		Silver Lake, Waushara County

RARE SPECIES

The following species were collected during this study and are considered rare in the state.

COLEOPTERA-beetles

Hydrophilidae (water scavenger beetles)

Enochrus consortus Green

This species occurs in a variety of lentic habitats. Single specimens were collected from the "marsh" within the Mosquito Hill Nature Center (SCH023), and from Pikes Peak Flowage (SCH024). There are 24 county records and 210 individuals known (Hilsenhoff 1995), with 81% having been collected by blacklight traps at a single location in southern WI.

Enochrus perplexus (LeConte)

This species is more rare in Wisconsin than the previous species of *Enochrus*. Hilsenhoff (1995) reported only 17 adults from 15 counties; this data reveals that only single specimens are collected when they are found. Indeed, single specimens were collected during the current study from Pikes Peak Flowage (SCH024) and the Navarino Bog (SCH53). Adults have been collected from a variety of habitats, and when coupled with their seemingly solitary behavior, it is too difficult to speculate on their natural history.

Hydrobius melaenus (Germar)

Adults of this uncommon beetle occur in small, spring-fed streams. Three specimens were taken from Murry Creek (SCH031) and one from a spring-seep feeder to Cedar Creek on Todd Close's property (SCH020). Hilsenhoff (1995) reported 15 county records and a total of 76 specimens; 4 additional county records are known.

Hydrochara spangleri Smetana

This species is an inhabitant of shallow lentic habitats in floodplains of rivers. Hilsenhoff (1995) reported a total of 193 specimens from 11 counties; however, 91% of his specimens were collected from one specific area along the lower Wisconsin River. Three sites during the current study yielded adults of this species: a flooded woodland pool beside the road within the LaSage Property (n=16) (SCH006), a single specimen from the oxbow and 5 adults from the marsh within the Mosquito Hill Nature Center (SCH022, 023).

Laccobius agilis (Randall)

Single adult specimens were collected from Murry Creek (SCH031) and Mud Lake (SCH064). Hilsenhoff (1995) reported this species as uncommon statewide, with 15 county records and only 28 specimens known. I am aware of 2 additional county records.

Laccobius reflexipennis Cheary

One adult was collected from the Embarrass River (SCH059). Less than 6 specimens were previously known from the state, and only 4 previous county records (Hilsenhoff 1995). One specimen was collected during last year's study (Schmude 1999).

Dytiscidae (predaceous diving beetles)

Agabetes acuductus (Harris)

This very uncommon species was collected at 2 sites: the swamp in the Maine Wildlife Area (SCH009, n=2) and the oxbow along Hwy 156 (SCH052, n=3). Only 32 specimens from 11 counties have been reported for Wisconsin (Hilsenhoff 1992). It occurs in woodland pools and wooded river sloughs, especially temporary habitats.

Agabus bicolor (Kirby)

Hilsenhoff (1993b) reported 14 county records (predominately northern counties) and 64 specimens for this species, and "at least 64% of the adults were found in association with *Sphagnum*, almost all in black spruce-tamarack...swamps." The Navarino Bog (SCH053) yielded 2 specimens during this study and 1 in 1999, but these records for Shawano Co. are not new. However, these adults do represent one of the southernmost records in the state.

Agabus wasastjernae (C.R. Sahlberg)

This rare species is known from *Sphagnum*-containing bogs, swamps, and marshes in northeastern and north-central WI, with 6 county records and 23 specimens (Hilsenhoff 1993b). A single adult was collected from the Navarino Bog (SCH053) in Shawano Co., which represents the southernmost record of this species in the state. In fact, it may also represent the southernmost record in North America (Larson 1996)!

Copelatus glypticus (Say)

A single adult was collected from the Navarino Bog (SCH053) and represents one of the northernmost records (Shawano Co.) in Wisconsin. Hilsenhoff (1993a) found 42 specimens from 13 counties, with only 1 county further north than Wood Co. (Bayfield Co.). The species occurs in a variety of aquatic habitats, but mainly in shallow temporary sites often associated with streams, which curiously does not describe the Navarino Bog.

Ilybius discedens Sharp

This species dwells almost exclusively in *Shagnum* swamps and bogs. Hilsenhoff (1993b) reported 141 specimens from 15 counties, with only 2 counties (Wood, Portage) occurring further south than Lincoln Co. A single adult was collected from the Navarino Bog (SCH053) in Shawano Co.; 2 specimens were taken from the same locality in 1999. This new county record is one of the southernmost records in the state.

Ilybius ignarus (LeConte)

This dytiscid beetle is an uncommon inhabitant in the southern two-thirds of Wisconsin and rare in the northern third. Although there are 30 county records, only 75 specimens have been reported (Hilsenhoff 1993b, unpublished data). Three sites in Outagamie Co. produced 5 adults: the "marsh" at the Mosquito Hill Nature Center (SCH023, n=2), Pikes Peak Flowage (SCH024, n=1), and Shaky Lake (SCH025, n=2). In addition, 1 specimen was collected in the Navarino Bog in 1999. Adults occur in permanent marshes, ponds, and swamps.

Ilybius incarinatus Zimmermann

Although this species is fairly common in the southern third of WI, it is uncommon in the central third, and rare in the northern third. There are 21 county records, but only 92 specimens reported (Hilsenhoff 1993b, unpublished data); most records are south of a line from Monroe to Winnebago counties, and more than half of the adults were trapped from the Horicon Marsh. A single adult was collected in Pikes Peak Flowage (SCH024) in Outagamie Co., a new county record. The species occurs in permanent ponds and marshes.

Liodessus flavicollis (LeConte)

This tiny species had been collected from 15 counties statewide for a total of 97 specimens (Hilsenhoff 1994,

unpublished data). It occurs in deeper water lentic habitats. A large collection of 36 specimens was taken from Lake Poygan (SCH042). Most were taken by scraping a net along the surface of a vertical retaining wall by a public boat landing.

Matus bicarinatus (Say)

Single specimens were collected from the spring pond on the LaSage Property (SCH003), and the Frog Pond and "marsh" within the Mosquito Hill Nature Center (SCH021, SCH023). This species was found in 13 counties in the southern third of WI, but is relatively rare (n=221), especially in the central part of the state (Hilsenhoff 1993a). Nine specimens were collected last year (Schmude 1999).

Rhantus sinuatus (LeConte)

This is an uncommon species statewide. Hilsenhoff (1993a) reported 76 individuals from 24 counties; I am aware of 1 additional county record. Six specimens were collected from the swamp in the Maine Wildlife Area (SCH009) and 1 from Pikes Peak Flowage (SCH024); all were collected in submerged bottle traps. Curiously, Hilsenhoff stated that all specimens he collected (except for 3) were collected in bottle traps, suggesting the adults are nocturnal. Although they can be found in a variety of lentic habitats, most often they are associated with *Sphagnum*.

Gyrinidae (whirligig beetles)

Gyrinus impressicollis Kirby

This is the third rarest species of whirligig beetles in Wisconsin (24 species), with only 6 northern-county records and 15 total specimens known (Hilsenhoff 1990). It occurs in larger lentic habitats and rarely flies into streams to overwinter, making it difficult to capture. Thus, it may be under represented. A single adult female was collected from Little Rice Lake in Forest Co. (SCH131), and it represents the northeastern-most record for WI.

Haliplidae (crawling water beetles)

Haliphus leopardus Roberts

Hilsenhoff and Brigham (1978) reported only 8 collections from ponds and sloughs in 7 counties, yielding 10 specimens; 1 additional county record is known (unpublished data). Two adults were taken from Lawrence Lake (SCH123) in Langlade Co., a relatively undisturbed, clear-water lake.

HETEROPTERA - true bugs

Corixidae (water boatmen)

Hesperocorixa semilucida (Walley)

This uncommon to rare species has been found in 11 southern counties with 45 specimens collected (Hilsenhoff 1984). A single specimen was taken from the "marsh" within the Mosquito Hill Nature Center (SCH023). Although this is not a new county record, it represents one of the northeastern-most records for the state. Adults overwinter in large rivers, but can be found in ponds during the spring.

Nepidae (water scorpion)

Nepa apiculata Uhler

This seemingly rare water scorpion has been collected in 16 counties (Hilsenhoff 1984, Cochran et al. 1992, unpublished data), with less than 40 individuals known. A single specimen was collected in a bottle trap from the oxbow along Hwy 156 near the Wolf River in Waupaca Co. (SCH052). This species occurs in a variety of lentic and lotic habitats, but typically in very shallow, mucky areas where there is dense vegetation.

Hebridae (velvet water bug)

Hebrus buenoi Drake and Harris

This species is apparently very rare in WI, with only 1 specimen having been reported (Racine Co.) (Hilsenhoff 1986), despite being collected in at least 8 sites in Minnesota (Bennett and Cook 1981). However, a single specimen was collected a few years ago in Perry Creek County Park in Jackson Co. during a WI DNR survey of the Black River State Forest. Another specimen was collected from the oxbow along Hwy 156 near the Wolf River in Waupaca Co. (SCH052). This represents the third specimen and county record known from Wisconsin.

Hydrometridae (marsh treader)

Hydrometra martini Kirkaldy

Hilsenhoff (1986) reported this species as uncommon throughout the state, with 18 county records and 61 individuals. It can be found walking on the surface in heavily vegetated lentic habitats. Fourteen specimens were collected from the following localities: oxbow pond within the Mosquito Hill Nature Center (SCH022, n=9), Pikes Peak Flowage (SCH024, n=2), Rat River wetland complex on Hwy W (SCH041, n=2), and the unnamed fishless lake State Natural Area in Waushara Co. (SCH047, n=1). Two of these sites represent new county records. Two additional county records were found in 1999 at the following localities: 80-acre Flowage in Shawano Co. (SCH99-111, n=1), and Wolf River Bottoms State Wildlife Area-flowages in Outagamie Co. (SCH99-115, n=3). Based on recent biotic surveys conducted for the WI DNR, it appears that this delicate water treader is more common and abundant in the state than first reported. Its small, cryptic stature has likely led to its lack of collection.

ODONATA - dragonflies/damselflies**Gomphidae (clubtails)**

Stylurus notatus (Rambur)

Several larval specimens of this species were collected in 1999 (Schmude 1999). One additional larval specimen was collected from the lower Wolf River at Gill's Landing (SCH101) in Waupaca Co. The species currently has a state rank of S2S3.

Lestidae (spreadwings)

Lestes inaequalis Walsh

A very large population of this species was found in the oxbow along Hwy 156 near the Wolf River in Waupaca Co. (SCH052); 56 large, mature larvae were collected along the flooded shoreline using aquatic nets and bottle traps. This species currently has a state rank of S2S3.

Lestes vigilax Hagen in Selys

A single larval specimen was collected in Lulu Lake (SCH057) in Shawano Co., and 2 larval specimens from Grenlie Lake State Natural Area (SCH094) in Waupaca Co. This species currently has a state rank of S3.

TRICHOPTERA - caddisflies

Leptoceridae (long-horned caddisflies)

Larval specimens of the following three species may exist in the University of Wisconsin's Insect Research Collection (UWIRC). However, the recent larval keys by Floyd (1995) and Glover (1996) have not yet been used to identify the specimens of these two genera that are housed in the UWIRC.

Oecetis nocturna Ross

Two larvae were collected in 1999 (Schmude 1999) and represented the first records of this species for the state. Single larval specimens were collected from Fountain Lake (SCH014) in Portage Co., and West Branch Shioc River (SCH054) in Shawano Co.

Oecetis near sp. A (Floyd 1995)

One larva was collected in 1999 (Schmude 1999) and represented a new state record. Single larval specimens were collected from Fountain Lake (SCH014) in Portage Co. and Lulu Lake (SCH057) in Shawano Co.

Triaenodes nox Ross (1 larval specimen)

One larva was collected in 1999 (Schmude 1999) and represented a new state record. One specimen was taken from the Shioc Mitigation Site (SCH008) in Outagamie Co.

DECAPODA

Cambaridae (crayfish)

Procambarus acutus (Girard)

This species is relatively rare in Wisconsin; Hobbs and Jass (1988) reported only 37 sites, and only 6 sites were located away from the extreme southeastern counties in the state. Eight specimens were collected in Outagamie Co. at the following localities: LaSage flowage (northern unit) (SCH004, n=1), a flooded woodland pool (SCH006, n=3) on the LaSage Property, and the "marsh" within the Mosquito Hill Nature Center (SCH023, n=4).

Palaemonidae (shrimp)

Palaemonetes kadiakensis Rathbun

This is the only species of freshwater shrimp that occurs in Wisconsin, where it is quite rare (7 counties). It occurs mainly in the St. Croix, Trempealeau-Black, Wisconsin, and Pecatonica-Sugar watersheds in the Mississippi drainage basin along the extreme western edge of the state (Hobbs and Jass 1988). The only other record is from Guth's Harbor, a lagoon along the Wolf River in Waupaca Co. A new Waupaca Co. site was discovered, the oxbow along Hwy 156 near the Wolf River (SCH052), where 11 specimens were collected.

CONCHOSTRACA - clam shrimp

Lycneus brachyurus Muller

Many specimens were collected in the McDonald Flowage (SCH99-110) and Deer Creek Wildlife Area (SCH99-114) in 1999 (Schmude 1999). A single specimen was collected from the Shioc Mitigation Site (SCH008) in 2000. In the 1999 report (Schmude 1999), I mentioned that I was unaware of any published records of this species in Wisconsin. However, Schneider and Frost (1996) reported it from ponds in the Northern Highland Lake District in Vilas Co.

NOTABLE SITES

Very Large Rivers

The 1999 report (Schmude 1999) stated that the very large rivers were considered the most important water bodies with regard to abundance and diversity of aquatic macroinvertebrates within the lower Wolf River Watershed. These very large rivers could not be adequately sampled or re-sampled in 2000 due to very high water levels. However the upper Wolf River Watershed did not receive the same rainfall amounts, and water levels were much lower, making it easier to access these sites. Two very large rivers were sampled, the Wolf and Red rivers. High taxa richness values (40-53) and abundance of aquatic macroinvertebrates were found, similar to what was discovered last year when values of taxa richness of 38 to at least 80 were recorded. Two outstanding sites on the upper Wolf River were located at Wolf River Landing Road (Langlade Co.) and Meister-Stuckley Road (Oneida Co.). The Wolf River at Chaney Lane (Forest Co.) did not produce taxa richness values or abundance data that were as high as other sites along the Wolf River. This site seemed to be disturbed, with dark algal mats covering the rocks, and a perceived water quality of only fair. It is not clear what might be causing this disturbance. The site on the Red River was located at the canoe landing near Gresham where the waterfall area exists. This site was particularly difficult to sample due to high water, raging currents, and bedrock substrates. Undoubtedly, taxa richness would have been much greater at this site if a more thorough effort could have been accomplished.

Medium to Large Rivers

Thirteen medium to large rivers were sampled. Taxa richness ranged from 18 in Ninemile Creek (Langlade Co.) to 71 in the Embarrass River (Shawano Co.). Most appeared to have good water quality, with high taxa richness and species that were intolerant to organic enrichment. The rivers included: Little Wolf, Crystal, Pine, Waupaca, and the branches of the Embarrass.

The Embarrass River at Hayman Park near Pella (Shawano Co.) was an exceptional area. Three separate sites within the park were sampled based on their apparent differences in habitat. One site was located within the waterfalls area (SCH058), another at the bridge where there was a relatively shallow, sandy run (SCH059), and another downstream from the bridge at the first large, wide, shallow riffle area (SCH060). Taxa richness ranged from 36-71 among the three sites, with an overall richness value of an amazing 94 for the entire stretch of the riverway; this value is assuredly still quite low because worms, many small larvae of flies, and other less conspicuous species were under represented. However, this was the highest taxa richness value observed within the entire Wolf River GMU for the two-year study.

The Shioc River in Navarino (Shawano Co.) was also interesting because of the very high numbers of stoneflies that were present (mainly *Perlesta*). At the same time, prey items such as baetid mayflies and hydropsychid caddisflies were not as equally abundant, despite a seemingly ideal habitat (shallow, fast water with abundant rubble and debris). Taxa richness (51) was high.

An exception to the good quality rivers was the West Branch of the Shioc River where agricultural runoff appeared to be having an impact on the river, despite a relatively high richness value of 41. I suspect that if the impacts could be eliminated or mitigated, water quality in this stream would improve dramatically. The fauna in the stream was indicative of a cold to cool-water stream, with relatively intolerant species present, but in low numbers.

Small to Medium-sized Streams

A total of 37 different streams in this category were sampled. Taxa richness values ranged from 5 in Pearl Creek (Portage Co.) to 47 in Krause spring and creek (Langlade Co.), but there were very few new county records discovered for species. Low richness values for Pearl, Allen (Portage), and an unnamed creek

(SCH063-Waupaca Co.) (Table 1) may not necessarily be attributed to man-made disturbance, but perhaps to very cold temperatures and lack of suitable, heterogeneous substrates. Overall, most of the streams indicated very good water quality, with many of the same taxa present in most of the streams. In fact, with the development of time and financial constraints in the study, and because of the perceived sameness in the fauna, the macroinvertebrate samples from 10 streams within this category were not taxonomically processed for this report (see Table 1)

Shallow Marshes, Flowages, Floodplains

Most of these types of water bodies had large numbers of macroinvertebrates with relatively high diversity. In general, the macroinvertebrate communities in these habitats could be summarized as being dominated by very common, Aweedy \cong species; species that are abundant throughout the state and are quick to colonize new bodies of water and areas that have been disturbed. Nine sites were sampled in 2000, all in the lower Wolf River Basin. Taxa richness values ranged from 5 in the LaSage flowage (SCH004, northern unit) to 67 in the "marsh" within the Mosquito Hill Nature Center (SCH023). Habitats that had populations of fish were less productive and diverse with regard to macroinvertebrates.

Three sites were sampled in both years: LaSage flowage (SCH005, southern unit), McDonald Marsh (SCH011, northern unit), and the Shioc Mitigation Site (SCH008). Bottle traps were used exclusively in 2000, resulting in additional taxa being found compared to 1999. As a result of the two-year collecting effort, relatively high taxa richness values were observed: 34 (LaSage), 49 (McDonald), and 58 (Shioc).

Two other sites of notable mention include Pikes Peak Flowage (SCH024), which was sampled at a site further west than in 1999, and the "marsh" at Mosquito Hill. Pikes Peak yielded 41 taxa with 7 new county records, while the marsh produced 67 taxa, but only 1 new county record. Both were very productive and harbored large invertebrate populations.

Oxbows

Two oxbows were sampled, and both proved to be extremely productive sites. The oxbow within the Mosquito Hill Nature Center (SCH022) produced 31 taxa. The biggest surprise during the study, however, was the oxbow on Hwy 156 in Waupaca Co. (SCH052) near the Wolf River. Net sampling along the margins of the oxbow resulting in an amazing mass of invertebrates; it was basically an invertebrate soup. Large lepid damselflies (*Lestes inaequalis*) dominated the biomass, but other large invertebrates were also abundant, including the rare freshwater shrimp *Palaemonetes kadiakensis*. Diversity was astounding (67 total taxa) when compared to the relatively little time that was spent sampling the area with nets (only a short stretch of shoreline was sampled). Bottle traps were deployed on two different occasions; each time the water level in the oxbow dropped a few feet leaving most of the traps out of the water, and yet 42 taxa were collected using bottle traps. In addition, fish inhabit the oxbow, such as northern pike (*Esox lucius*), along with some very large fish that were not identified. Normally, fish inhibit macroinvertebrate diversity and production, but certainly not in this case. Although only 4 new county records were established, several rare to uncommon species were found. In addition, large populations of common species also occurred.

Bogs and Swamps

Three bogs (Shaky Lake, Navarino Bog, Mud Lake Bog) and 1 swamp (Maine Wildlife Area) were sampled in 2000; the swamp and Navarino Bog were sampled last year also. Shaky Lake and Mud Lake Bog were relatively unproductive, but were very difficult to sample. The fauna in each lake was composed of mostly common species, but a more thorough sampling effort would likely show a more diverse, bog-inhabiting community.

The swamp within the Maine Wildlife Area next to Beyer Road was sampled with bottle traps three times during the past two years. A total of 38 taxa was collected in 1999 (Schmude 1999, bottle traps were used instead of a net as listed). In 2000, 25 taxa were collected from May 17-19, while 36 taxa were collected from June 5-7, resulting in 41 different taxa. Overall, 52 different taxa were found at this site during the two years, with 5 representing new county records. The extremely rare water scavenger beetle *Hydrochara leechi* was collected last year (Schmude 1999), but was not found in 2000. The swamp has a very large population of *Hydrochara*; 320 specimens were collected in total as follows: 297 *Hydrochara obtusata*, 17 *H. simula*, 5 *H. soror*, and 1 *H. leechi*. Several other rare to uncommon species of aquatic macroinvertebrates were found in this highly productive swamp.

The Navarino Bog is a very unique site for east-central Wisconsin. Nets and/or bottle traps were used to collect macroinvertebrates during the past two years. In total, 26 taxa were found in 1999 (Schmude 1999), while 14 taxa were collected in 2000, resulting in 31 different taxa for the two years. In addition, 15 or nearly half of the taxa were new county records! Most of the species represented bog inhabitants, and for many of them this site currently represents their southernmost (or in some cases the northernmost) limit in the state.

Springs, Spring Ponds

Five sites were sampled in 2000. The spring pond on the LaSage Property (SCH003) was sampled again resulting in a total of 39 taxa collected during the two years. Two spring ponds on the Todd Close Property (SCH016,017), along with one in Portage Co. (SCH111) yielded richness values of 21 to 26, with the fauna dominated by very common species and typical spring-pond species.

Ponds, Woodland Pools

Six sites were sampled: two on the LaSage Property (SCH006,007), and one each on the Todd Close Property (SCH018), Mosquito Hill Nature Center (SCH021), State Natural Area (SNA) in Waushara Co. (SCH048), and near Myklebust Lake (SCH099). Except for Mosquito Hill and the SNA, the fauna was not very diverse and was typical for ponds (very common species). The Frog Pond in the Mosquito Hill Nature Center and the woodland pool in the State Natural Area had considerably greater diversity, but only a total of 3 new county records. Again, the fauna was dominated by fairly common species.

Lakes

Twenty different lakes were sampled, with an additional one sampled during a different study (Silver Lake, Waushara Co.). Taxa richness values ranged from 4 in Himley Lake-south end (Forest Co.) to 38 in Fountain Lake (Portage Co.). The macroinvertebrates that contributed to the high richness value for Fountain Lake were collected in a relatively small area from the boat landing to the impoundment dam; the rest of the lake was not sampled. On the other hand, lower richness values (16-24) were obtained for Pickerel, Sunset, and Wolf lakes (Portage Co.) despite extensive sampling along greater stretches of shoreline. Obviously, lakes within the same general area and with the same general size have macroinvertebrate communities that vary in abundance and diversity, and understanding what contributes to this disparity is very difficult.

One lake of special interest was Lawrence Lake in Langlade Co. This lake is a wild lake without any

development, except for a dirt road and boat landing. The water is very clear with rubble, submerged logs, short macrophytes, and sand along the littoral zone; some quieter bay areas have muck and emergent vegetation. A fairly diverse (34 taxa richness) and abundant macroinvertebrate fauna occurred on a variety of the substrates that were present.

Another lake of interest was Little Rice Lake in Forest Co., near the headwaters of the Wolf River. The lake had an abundant and diverse macroinvertebrate fauna (37 taxa richness), which was probably due to diverse habitats and substrates. Minimal collecting was accomplished at only one boat landing on this complex lake. Taxa richness would assuredly increase dramatically with a more thorough sampling effort.

Silver Lake was studied in 1995 as part of a WI DNR shoreline study (WDNR 1996, Schmude et al. 1998). A total of 21 sites along the lakeshore were sampled by placing artificial substrates in shallow water for about 6 weeks immediately after ice-out. Taxonomic analysis of all macroinvertebrates resulted in a total taxa richness value of 117 for the study. Obviously, more intensive, quantitative studies can reveal high diversities of aquatic macroinvertebrates.

Mosquito Hill Nature Center

The Center has at least three separate aquatic habitats on the property: the Frog Pond, Marsh, and Oxbow. Although some species of aquatic macroinvertebrates occurred in each of the habitats, others occurred in only one or two of the sites. Taxa richness was quite high in each: 31 (Oxbow), 41 (Frog Pond), 67 (Marsh). However, as a single unit, taxa richness was very high for the Center (92!). Four new county records were established, and several additional rare species were collected. Macroinvertebrate productivity was also quite high. Undoubtedly, additional species occur within the habitats that were sampled. Also, the Center has additional aquatic habitats on the property. This area is certainly an outstanding natural resource for the region in terms of aquatic invertebrate production and diversity. Additional survey work in this area should be considered.

CONSIDERATIONS for MANAGEMENT and PROTECTION

Several considerations were discussed in Schmude (1999) and will not be repeated, although they remain pertinent.

Streams

Many of the streams that were sampled appeared to be good shape. Some exceptions include: upper Rat River (SCH038,039) in Outagamie Co., Alder Creek (SCH043,044) in Winnebago Co., Peterson Creek (SCH096) in Waupaca Co., Twin Creek (SCH055), West Branch Shioc River, and Shioc River (SCH056) in Shawano Co. All of these have questionable or clear water-quality problems. However, based on the fauna that was present in the streams, all seem to have the capability to recover if agricultural and suburban nutrient inputs could be eliminated or reduced.

Oxbows

The two oxbows that were studied appeared to be very valuable aquatic resources. These habitats are naturally and frequently "disturbed" by fluctuating water levels, but the communities that inhabit these sites have obviously adapted to this situation in a very productive manner. It is not known if man-made disturbances might affect these two sites, but I suggest that natural resource managers consider these sites (and other potentially similar sites) as being very important for invertebrate production and as refugia for species diversity.

Swamps

The swamp in the Maine Wildlife Area is another important site for invertebrate production and diversity. A potential problem was observed during a heavy rain event when soil from the agricultural field across from Beyer Road was washed into the ditch, traveled under the road in a culvert, and emptied into the Wildlife Area. Siltation, organic nutrients, and chemical contaminants are all potential problems that should be examined at this site.

Lakes

One issue that was brought to my attention by an area resident and fisherman was the susceptibility of many lakes in the southwestern Wolf River Basin (Portage, Waupaca, Waushara counties, and perhaps elsewhere) to disturbance by water jet skis. Many of these lakes are shallow and very soft-bottomed (marly). It seems obvious that considerable disturbance and destruction of the fragile littoral zone would occur if one or more jet skis were indiscriminately used in these lakes. Perhaps all it would take would be a few hours with several jet skis to disrupt life cycles of many species for the entire year, or years for species with longer life cycles (ephemerid mayflies, dragonflies, crayfish). In addition, some lakes have outlets, such as Fountain Lake in Portage Co., which empties into Emmons Creek. A considerable amount of sediment could be sent downstream and disrupt the fauna in both the lake and creek. It seems clear that some lakes are quite susceptible to sediment disturbance and that a ban on the use of jet skis in these lakes should be seriously considered.

FUTURE INVENTORY

If future inventory work is being considered, a prioritization of specific sites and habitats at specific times of the season should be accomplished for the lower Wolf River Basin. This would maximize time, minimize costs, and result in specific data being collected. The upper Wolf River Basin remains under sampled and would certainly benefit from a more thorough survey, similar to the effort that was accomplished in the southern basin.

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